

137-58-4-6978

Vitreous Semiconductors

for this series of systems was found, and it was also found that the boundary substances may be obtained both in the crystalline and in the amorphous state. The σ of the compounds lying within the limits of glass formation had a magnitude attaining 10^{-3} mho/cm. It was found that the new vitreous substances are typical semiconductors, and σ may change by several orders of magnitude in the case of the boundary substances on transition from the vitreous to the crystalline state. Glasses do not have absorption bands in the 2-14 mm interval. By their chemical composition, these glasses may be designated as chalcogenic. The semiconductors investigated were distinguished by a low softening temperature (from 100-300°) and high brittleness. Structural investigation of the substances beyond the limits of the vitreous state show that some of them, when in the "crystalline" state, consisted of 2-phase systems of crystal and glass. In a study of the $\text{Tl}_2\text{Se} [x\text{Sb}_2\text{Se}_3(1-x)\text{As}_2\text{Se}_3]$ system, in which As replaced antimony, a second vitreous phase was found in the TlSbSe_2 compound. Thermal analysis of the 2-phase substance showed that the chemical compound dissolves into the vitreous component of the melt at a temperature above the liquidus. The reaction of the components in this system is described by the equation: $x(\text{Tl}_2\text{Se} \cdot \text{As}_2\text{Se}_3)$ vitreous phase $\cdot (1-x)(\text{Tl}_2\text{Se} \cdot \text{Sb}_2\text{Se}_3)$ crystalline phase. The following systems were also investigated: $x\text{As}_2\text{Se}_3(1-x)\text{Sb}_2\text{Se}_3$ and $x\text{Tl}_2\text{Se}(1-x)\text{As}_2\text{Se}_3$ with isomorphic substitution of

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Vitreous Semiconductors

Sb and As. The phase composition of the former was $x [1/6(\text{Sb}_2\text{Se}_3) \cdot 5/6 (\text{As}_2\text{Se}_3) \text{ vitreous phase} \cdot (1-x)\text{Sb}_2\text{Se}_3 \text{ crystalline phase}]$. The phase composition of the latter was $x(\text{Tl}_2\text{Se} \cdot \text{As}_2\text{Se}_3 + \text{Tl}) \text{ vitreous phase} \cdot (1-x) \text{TlSe crystalline phase}$.

N. Sh.

1. Semiconductors (Vitreous)--Structural analysis
2. Semiconductors (Vitreous)
--Thermal analysis

Card 3/3

Goryunova, N.A.

AUTHOR: GORYUNOVA, N.A.

PA - 2356

TITLE: Some Problems of Crystal Chemistry of Compounds with the Structure of Zinc Blende. (Nikotoryye voprosy kristallikhimii soyedineniy so strukturoy tsinkovoy obmanki, Russian).PERIODICAL: Izvestia Akad. Nauk SSSR, Ser. Fiz., 1957, Vol 21, Nr 1, pp 120 - 132 (U.S.S.R.)
Received: 4 / 1957

Reviewed: 5 / 1957

ABSTRACT: As a basis for this search for new semiconductors, the authoress chose compounds with the structure of zinc blende and the elements of the IV^b - subgroup of the periodic system. The present work contains some qualitative deliberations which are based upon the position of the elements forming the connections in the periodic system. These deliberations served as a working hypothesis for sorting out the group of semiconductors according to a crystalline-chemical distinguishing mark.

The group of binary compounds with the structure of the zinc blende and the elements of the IV^b-subgroup. The far-reaching qualitative agreement of the properties of these substances is based upon their chrystalline-chemical similarity. In both cases a tetrahedronic arrangement of the atoms and tetrahedrally directioned covalent bindings exist. The group of these binary compositions is, lastly, shown in form of a table. Several semiconductors belonging to this group are enumerated.

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Some Problems of Chrystal Chemistry of Compounds with the
Structure of Zinc Blende. PA - 2356

The modification of the type of the binding in the previously mentioned group: This group not only possesses structural but also crystalline-chemical similarities. The reason for these similarities is the modification of the type of the bindings corresponding to the position of the elements in the periodical system in accordance with certain laws. Several modifications of these laws are enumerated individually.

The isomorphism of the compounds with the structure of the zinc blende: Such substances are of great interest for the investigation of the modification of electric properties in the case of a modification of the relations between the different types of bindings which permit isomeric substitution within wide limits.

In conclusion the position of the group of compounds in consideration of the structure of the zinc blende within the other anorganic compositions is discussed.
Leningrad Physical-Technical Institute of the Academy of Science
of the U.S.S.R.

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ASSOCIATION:
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Library of Congress.

GORUNOVA, N.A.

AUTHOR: ORMONT, B.F., GORYUNOVA, N.A., AGEYEVA, I.N., PA - 2357
FEDOROVA, N.N.

TITLE: On the Theory of Phases with Variable Composition with the Structure of Zinc-Blende. (On the investigation of the possible domain of the homogeneity of compounds of the type $A^I B^X$). (K teorii faz peremennogo sostava sostrukturny tsinkovoy obmanki (Ob issledovanii vosmozhnoy oblasti gomogenosti svedineniy tipa $A^{III} B^V$, Russian).

PERIODICAL: Izvestiia Akad. Nauk SSSR, Ser. Fiz., 1957, Vol 21, Nr 1, pp 133 - 140 (U.S.S.R.)
Received: 4 / 1957 Reviewed: 5 / 1957

ABSTRACT: The present paper gives a survey of investigations bearing on the matter: Most of the substances crystallizing with the structure of rock-salt (oxides, nitrides, carbides, and others) are phases with variable composition. Even in the case of very narrow homogeneity domains of a phase, its physical properties sometimes change considerably within the homogeneity domain. This applies especially in the case of electric properties. Substances with the structure of zinc-blende do not represent a special type of structure, they have a tetrahedral configuration of the coordination sphere. Substances with the structure of wurzite have the same configuration. In the case of compounds of the type $A^I B^{VI}$ the following applies: With increasing polarization first the struc-

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On the Theory of Phases with Variable Composition with the Structure of Zinc-Blende.

ture of NaCl, then the structures of wurzite, and finally that of zinc-blende appear. The methods of synthesis of the compounds GaAs, InAs, and InSb are then discussed.

Next, a synthesis of the compounds of the type $A^{\text{III}}B^{\text{V}}$ developed by the Physical-Technical Institute is described; here rather high temperatures are necessary. For the determination of the breadth of the homogeneity domain it is necessary to carry out precise x-ray analyses and chemical phase-analyses. (3 tables).

ASSOCIATION: Physical-Chemical Institute L.Ya.KARPOV. Leningrad Physical-Technical Institute of the Academy of Science of the U.S.S.R.

PRESENTED BY:

SUBMITTED:

AVAILABLE: Library of Congress.

Card 2/2

Goryunova, N. A.

AUTHORS: Borshevskiy, A. S., Goryunova, N. A.,
Takhtareva, N. K.

57-27-7-2/40

TITLE: An Investigation of the Microhardness of Some Semiconductors
With a **Zinc Blende** Structure (Issledovaniye mikrotverdsti neko-
torykh poluprovodnikov so strukturoy tsinkovoy obmanki).

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1957, Vol. 27, Nr 7, pp. 1408-1413
(USSR)

ABSTRACT: The microhardness of semiconductors comprised in a crystallo-
chemical group according to the principle of a common type of
linkage and a common structure was investigated, the obtained data
were compared with the other physico-chemical properties and the
correlation with the electric parameters of the semiconductors
of this group was determined. The data of the first tests with
some semiconductors with Wurtzit-, zincblende- and diamond-struc-
ture are given here. The microhardness-values of these semicon-
ductors were determined. When gallium arsenide was crystallized
in a narrow tube it showed a hermaphroditic (twin-crystal) forma-
tion and the microhardness increased. But also under conservat-
ion of the same crystallization-conditions the greatest variations
were found to occur in this compound by measuring the microhard-
ness. The authors could not yet determine the reasons for this.
A certain dependence of the microhardness on the purity of the
applied materials was observed in the tellurides (Ga_2Te_3), In_2Te_3 ,

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An Investigation of the Microhardness of Some Semiconductors With a **57-27-7-2/40**
Zinc Blende Structure.

ZnTe). It is shown that the microhardness becomes smaller in the isoelectron-compound -series with strengthening of the ion-bound, which corresponds to the character of variation of the hardness according to V. M. Gol'dshmidt, UFN, 9(6), 811, 1929,. There are 4 figures, 2 tables and 5 references, 4 of which are Soviet.

ASSOCIATION: Physico-Technical Institute AS USSR, Leningrad. (Fiziko-tekhni-cheskiy institut AN SSSR, Leningrad)

SUBMITTED: March 11, 1957

AVAILABLE: Library of Congress

1. Semiconductors-Hardness-Determination 2. Zinc blende-Applications

Card 2/2

SOV/137-58-10-20833 D

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 10, p 69 (USSR)

AUTHOR: Goryunova, N.A.

TITLE: An Investigation Into Semiconductor Chemistry (Issledovaniya v oblasti khimii poluprovodnikov)

ABSTRACT: Bibliographic entry on the author's dissertation for the degree of Doctor of Chemical Sciences, presented to the In-t obshch. i neorgan. khimii AN SSSR (Institute of General and Inorganic Chemistry, Academy of Sciences, USSR), Leningrad, 1958

ASSOCIATION: In-t obshch. i neorgan. khimii AN SSSR (Institute of General and Inorganic Chemistry, Academy of Sciences, USSR), Leningrad

1. Semiconductors---Chemical properties 2. Electrochemistry

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5(4)

SOV/30-58-11-3/48

AUTHORS:

Luzhnaya, N. P., Doctor of Chemistry,
Goryunova, N. A., Candidate of Chemistry

TITLE:

Some Problems of the Chemistry of Semiconductors (Nekotoryye
problemy khimii poluprovodnikov)

PERIODICAL:

Vestnik Akademii nauk SSSR, 1958, Nr 11, pp 17-21 (USSR)

ABSTRACT:

A first success in this field was the discovery of semiconductor properties of gray tin by A. F. Ioffe, A. I. Blum, N. A. Goryunova. The prediction and discovery of semiconductor properties of binary compounds of the type of zinc blende (ZnS) showed the great importance of physico-chemical ideas in this field. (A. F. Ioffe, A. R. Regel'). Formally semiconductor chemistry was introduced to the Soviet Union on the occasion of the Eighth All-Union Conference on Semiconductors in Leningrad 1955 by establishing a special section. In order to produce new semiconductors with properties determined in advance the chemical nature of these semiconductors has to be investigated, especially the electron interaction of their atoms. Recently some papers have been published abroad on problems of chemical compounds in semiconductors. In the Soviet

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Some Problems of the Chemistry of Semiconductors

Union these researches have just been started. (A. G. Samoylovich, A. I. Gubanov, Ya. K. Syrkin). Z. G. Pinsker obtained data on the characteristic features of electron density distribution in semiconductors by means of electronography. Semiconductor properties are of great importance in boundary layers of two materials. The physico-chemical analysis is considered as an effective instrument in solving the problems mentioned. Researches on complicated semiconductor systems have been started in the Soviet Union in the Fiziko-tekhnicheskii institut i Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Physico-Technical Institute and Metallurgical Institute imeni A. A. Baykov AS USSR). These researches were to be developed in the chemical institutes, especially in the Institut obshchey i neorganicheskoy khimii im. N. S. Kurnakova (Institute of General and Inorganic Chemistry imeni N. S. Kurnakov) where in 1958 the Laboratoriya fiziko-khimicheskogo analiza poluprovodnikovyykh veshchestv (Laboratory for Physico-Chemical Analysis of Semiconductor Materials) has been established. Such a laboratory is also established in the Institut fiziki i matematiki Akademii nauk Azerbaydzhanskoy SSR (Institute of Physics and Mathematics AS Azerbaydzhanskaya SSR).

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SOV/30-58-11-3/40

Some Problems of the Chemistry of Semiconductors

Investigations of mechanic properties are to be carried out during the next time in the Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors AS USSR). Also their properties under high temperature are to be examined. Investigation of materials of spinel structure is also of great importance (G. A. Smolenskiy). The correlation method is considered very useful in connection with these researches (V. P. Zhuze). Dr. A. Petrov, M. S. Mirgalovskaya, developed methods for producing semiconductor materials with high purity degree in form of perfect monocrystals. Papers by I. V. Tananayev, A. V. Novoselova, I. P. Alimarin on this field are mentioned. Finally the authors mention the great importance of semiconductor chemistry for establishing a new technique.

Card 3/3

78-3-3-21/47

AUTHORS: Gorshkov, I. Ye. (Deceased), Goryunova, N. A.

TITLE: The Quasibinary Section of GaSb-InSb of the System Gallium-Indium-Antimony (Kvazibinaryy razrez GaSb-InSb sistemy Galliy-indiy-sur'ma)

PERIODICAL: Zhurnal Neorganicheskoy Khimii, 1958, Vol. 3, Nr 3, pp. 668-672 (USSR)

ABSTRACT: The quasibinary section of these alloys was examined by thermal analysis, determination of microstructure as well as by radiographic analysis of this system. The nature of the interaction of the compounds in the system GaSb-InSb is like that in the system AlSb-InSb. With the produced alloys microstructure-investigations and hardness determinations were performed. At first the solid solution, enriched with the compound GaSb, and at the end the solid solution, enriched with InSb, crystallized from the system. The microstructure investigation of the alloy containing 25 % InSb shows a smaller dendritic heterogeneity. The X-ray structural analyses according to Debye-Scherrer also showed the

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The Quasibinary Section of GaSb-InSb of the System Gallium-Indium-Antimony

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formation of solid solutions. The parameter of the space lattice in the homogenized alloys changes according to the linear law from GaSb to InSb. There are 4 figures and 15 references, 6 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk SSSR
(Physical-Technical Institute, AS USSR)

SUBMITTED: June 25, 1957

Card 2/2

AUTHORS: Goryunova, N. A., Kolomiyets, B. T., 57-28-5-11/36
Shilo, V. P.

TITLE: Vitreous Semiconductors (Stekloobraznyye poluprovodniki)
 II. Glass Formation in Alloys of the Chalcogenides of Phosphorus, Arsenic, Antimony, Bismuth and Thallium (II. Stekloobrazovaniye v splavakh khal'kogenidov fosfora, mysh'yaka, sur'my, vismuta i talliya)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 5, pp. 981-985 (USSR)

ABSTRACT: In the present paper the authors attempted to determine the maximum limit of the vitreous state by means of a variation of the cooling conditions in the earlier described systems. This became a necessity in connection with the investigation of their semiconductor properties. A comparison of these properties in substances of identical chemical composition, however, in different states, - in the crystalline and in the vitreous - proves to be of great interest. Alloys of 7 pseudobinary sections of the ternary systems served as investigation samples: 1) $As_2Te_3-As_2S_3$; 2) $As_2S_3-As_2Se_3$; 3) $As_2Se_3-As_2Te_3$; 4) $As_2S_3-Sb_2S_3$; 5) $As_2Se_3-Sb_2Se_3$; 6) $Tl_2S-As_2S_3$; 7) $Tl_2Se-As_2Se_3$ as well as alloys of the pseudobinary section of the system Tl_2Se .

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Vitreous Semiconductors. II. Glass Formation in Alloys of the Chalco-57-28-5-11/36
genides of Phosphorus, Arsenic, Antimony, Bismuth and Thallium

.As₂Se₃-Tl₂Te.As₂Te₃. They were investigated under two kinds of cooling conditions. It is important for the investigation of physical properties and for the clearing of the mechanism of glass formation in chalcogenous glass to investigate the crystallization processes and the phase composition of the crystallized substances. This problem was studied by the authors together with the Institute for Crystallography, of the AS USSR (Laboratory of Professor Z. G. Pinsker). A comparison of works conducted at the same objects showed that the crystallization process can proceed in various directions under different conditions. In the crystallization of substances in the shape of blocks it is possible to characterize the intermediate stages of annealing by the simultaneous coexistence of the crystalline and the vitreous phase. On the contrary only completely crystalline substances are obtained after annealing of thin films. On the strength of the preliminary investigations it can be said that, as was to be expected, the transition of all investigated substances into the crystalline state is possible. However, this process is complicated. At an approach to the limits of glass formation the crystallization in general

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Vitreous Semiconductors.II. Glass Formation in Alloys of the 57-28-5-11/36
Chalcogenides of Phosphorus, Arsenic, Antimony, Bismuth and Thallium

is facilitated. Investigations in this direction are continued. In this paper the limits of glass formation in systems on a phosphorus basis were moreover, investigated. The systems: $As_2S_3-P_2S_3$ and $As_2Se_3-P_2Se_3$ were synthesized. The glass formation was also determined under two kinds of synthesis conditions - at slow and quick cooling (hardening) (figure. 3). The phosphorus sulfides and -selenides permit together with other chalcogenides to produce a great number of vitreous substances. The properties of these substances should be subjected to a thorough examination. In the paper (Ref 6) then was mentioned that the semiconducting glasses admit a considerable deviation from the stoichiometrical composition. From this viewpoint the ternary system $Tl-As-Se$ was investigated at slow cooling (figure 4). It can be discerned, that the domain of glass formation in the system $Tl-As-Se$ is comparatively great. Therefore the diagram of the pseudobinary system $TlSe-As_2Se_3$, which assumes an interaction of the stoichiometrical amounts of the binary components, yields considerably less vitreous components than that diagram, which is

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Vitreous Semiconductors.II.Glass Formation in Alloys of the 57-28-5-11/36
Chalcogenides of Phosphorus, Arsenic, Antimony, Bismuth and Thallium

obtained on the basis of the intial elements. There are 4
figures and 10 references, 4 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR, Leningrad
(Physico-technical Institute, AS USSR, Leningrad)

SUBMITTED: April 15, 1957

1. Semiconductors--Phase studies

Card 4/4

AUTHORS: Goryunova, N. A., Fedorova, N. N.
Sokolova, V. I.

SOV/57-58-8-9/37

TITLE: On Indium Phosphide With Stoichiometrical and Non-
Stoichiometrical Composition (O fosfide indiya stekhiometricheskogo i nestekhiometricheskogo sostavov)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Nr 8, pp. 1672 - 1675
(USSR)

ABSTRACT: This is an attempt to determine the width of the homogeneous zone in InP, at least in first approximation, by determining the lattice constants of indium phosphide, when an excess of one or the other component is introduced into the indium phosphide. Moreover, it was intended to obtain reliable data on the identity period of indium phosphide which was produced from pure substances. The indium used in the synthesis contained only negligible traces of copper, according to data from spectral analysis. The phosphorus which was purified by repeated washing with hydrochloric acid contained copper, aluminum, iron, magnesium, and silicon in quantities of a few thousands of a percent. Bismuth, antimony, lead, tin, zinc,

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On Indium Phosphide With Stoichiometrical and Non-Stoichiometrical Composition

SOV/57-58-8-9/37

and arsenic could not be observed. According to data from spectral analysis all samples were produced by an immediate combined melting of the components. The procedure in the production of indium phosphide samples with an excess of indium or of phosphorus is described. The stoichiometrical InP was produced by two methods, which are described in short. The samples with an indium excess all exhibited a picture typical of two-phase substances. The samples with a phosphorus excess also yielded the picture of a two-phase substance. The phosphorus veins and the inclusions had a red color. No indications of a second phase were found in the polished sections of stoichiometrical indium phosphide samples. In the X-ray analysis a simple and a refined powder method were applied. The refined X-ray diagram was taken with a Cu K_α -radiation

according to two methods. The evidence presented shows that the identity period of indium phosphide is equal to $5,8693 \text{ \AA}$ and that it does not vary within a range of $\pm 0,0006 \text{ \AA}$, if an excess of the one or the other component is introduced. There is every indication that the width of the homogeneous zone

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On Indium Phosphide With Stoichiometrical
and Non-Stoichiometrical Composition

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in indium phosphide is very narrow. Professor D. N. Nasledov
and Professor B. F. Ormont discussed the results of the work
with the authors. There are 2 figures, 1 table, and 19
references, 4 of which are Soviet.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskii institut AN SSSR
(Leningrad Physical and Technical Institute, AS USSR)
Nauchno-issledovatel'skiy akkumulyatornyy institut
(Scientific Research Institute of Accumulators)

SUBMITTED: October 26, 1957

Card 3/3

AUTHORS: Goryunova, N. A., Radautsan, S. I. SOV/57-23-9-8/33

TITLE: Solid Solutions in the System InAs - In_2Se_3 (Tverdyye rastvory v sisteme InAs - In_2Se_3)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, ^{vol 28} Nr 9, pp. 1917-1921 (USSR)

ABSTRACT: This paper is a continuation of the investigations of the homogeneous domains with a zincblende structure in the pseudobinary cross-sections of ternary systems which were carried out in the Leningrad Physical and Technical Institute. The results of the investigation of the InAs - In_2Se_3 -system according to various methods show that in this system a number of solid substitution solutions are found ranging from 100% InAs to 40% InAs-60% In_2Se_3 , inclusively. As was found in the GaAs - Ga_2Se_3 -system (Ref 5) the diffusion in the solid state is obstructed in connection with the covalent character of the chemical binding. A long-term annealing, however, leads to a certain homogenization of the alloys, which

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Solid Solutions in the System InAs - In_2Se_3

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is substantiated by the diminution of the dendrites. According to the results of the preliminary experiments annealing under pressure considerably accelerates this process. The possibility of the formation of solid solutions in the InAs - In_2Se_3 -system indicates that the type of binding in both binary components is very similar. In the near future the electrical properties of samples of this system will be thoroughly investigated in order to find out whether they are qualified for practical use. An X-ray analysis was carried out by I.I. Agayeva and R.V. Struchalina. The authors express their thanks to Prof. D. M. Nosledov for his constant interest in the progress of this study, and his help in creating the necessary conditions for making it. There are 7 figures, 2 tables, and 11 references, 4 of which are Soviet.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskii institut AN SSSR
(Leningrad Physical and Technical Institute, AS USSR)

SUBMITTED: October 14, 1957
Card 2/3

AUTHORS: Goryunov, M. A., Kolomiets, B. G.

004/07-2.1-1/53

TITLE: Vitreous Semiconductors (stekloobraznyye poluprovodniki)
IV. Mechanisms of Vitrification (IV.
o voprosu o zakononamost'akh stekloobrazovaniya)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Vol 28, No 9, pp. 1922-1932 (USSR)

ABSTRACT: This is a study of the glass formation capability of semiconductors. First information is presented bearing on the present state of problems connected with the chemical nature of glass formation as collected from recent publications. All these papers are confined to a study of oxide glasses or of high-polymeric organic glasses. In this paper a qualitative picture of glass formation is presented which is based upon experiments with a group of chalcogenes and of some other semiconductors concerning the character of the chemical binding. The authors arrived at the following conclusions: the glass formation is connected with the chemical nature of the atoms, with the character of electron interaction between the atoms and with the particular features exhibited by the short-range order in a molten state which are connected with

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Vitreous boric acid

OV/57-23-9-9/33

this interaction. The necessary condition of glass formation is the existence of a covalent binding in these substances in the solid and in the molten state. The metallization of the covalent bindings obstructs the glass formation. In extreme cases it is even prevented. The tetrahedron covalent bindings forming according to the Grima-Sommerfeld (Grima-Zommerfeld) rule which are not destroyed in the melt also prevent glass formation. There are 3 tables and 34 references, 21 of which are Soviet.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskii institut AN SSSR
(Leningrad Physical and Technical Institute AS USSR)

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NOV/20-120-5-28/67

AUTHORS: Goryunova, N. A., Burdiyan, I. I.

TITLE: Solid Solutions in the AlSb-GaSb System (Tverdyje rastvoiy v sisteme AlSb-GaSb)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol. 120, Nr 5, pp.1031-1034 (USSR)

ABSTRACT: The binary substances of the pseudo binary cross section of the ternary system Al-Sb-Ga in question are semiconductors of the type A^{III}B^V. Publications dealing with their properties are very numerous at present. The possibility of a formation of homogeneous domains in alloys of substances of this type is interesting for the production of semiconductors. Such alloys exhibit a combination of electric and physico-chemical properties more favorable for practical purposes than is the case with binary compounds. A short survey of publications is given (Refs 1 - 3). Apparently Kester and Toma (Koster and Thoma, Ref 1) did not take into account the circumstance that the main characteristic feature of these systems is the tendency to form non-equilibrium states. This is connected

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Solid Solutions in the AlSb-GaSb System

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with a distinctly marked covalent type of interaction between the atoms of these substances. One of the authors assumed that these solid solutions exist in reality. The results shown in the present paper confirmed this assumption. Since the substances immediately after the synthesis decidedly had a heterogeneous structure they were homogenized by means of a zone melting. This new step turned out to be very convenient before the thermal analysis. The alloys were investigated chemically by T. V. Cherkashina. The results obtained by the thermal analysis differ to a great extent from those obtained by Kester and Toma. They are shown in figure 1. The results of the authors prove that in the said system the interaction of the binary system under conditions which approach towards equilibrium has no eutectic character, but leads to the formation of solid solutions in a wide range of concentration. The rising content of GaSb increases the resistance of the alloys against the atmospheric humidity. Furthermore the phase diagram of a greater number of alloys was thoroughly investigated. The solid solutions produced are assumed to be solid substitution solutions. These results made possible the explanation of the contradiction between the data obtained

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Solid Solutions in the AlSb-GaSb System

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by the authors and those obtained by Küster and Toma. This contradiction consists in the substitution which takes place in systems of the same type with components which replace one another and deviate from one another according to all characteristics (GaP-GaAs and InP-InAs), whereas this is not the case with the system AlSb-GaSb in which the components which substitute one another are related to each other. From the data given in table 1 the conclusion may be drawn that the formation of solid solutions of the type $Al^{III}Sb^{V}$ in a wide concentration range takes place only if the relative difference of the electric affinity constant of the elements which substitute one another does not exceed 9,4 %. N. K. Takhtareva and A. G. Borshchevskiy assisted in this investigation. It was carried out in the laboratory of S. T. Kolomyets. There are 1 figure, 1 table, and 9 references, 6 of which are Soviet.

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Solid Solutions in the AlSb-GaAs System

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ASSOCIATION: Fiziko-tehnicheskiy institut Akademii nauk SSSR
(Physicotechnical Institute, AS, USSR)

PRESENTED: February 20, 1958, by A. M. Ioffe, Member, Academy of
Sciences, USSR

SUBMITTED: February 18, 1958

1. Semiconductors--Materials
2. Semiconductors--Production
3. Aluminum-antimony-Gallium systems--Properties
4. Aluminum-antimony-Gallium systems--Analysis

Card 4/4

24(6)

AUTHORS:

Goryunova, N. A., Radautsan, S. I.

SOV/20-121-5-22/50

TITLE:

The Solid Solutions in the System InAs-In₂Te₃ (Tverdyye rastvory v sisteme InAs - In₂Te₃)

PERIODICAL:

Doklady Akademii nauk SSSR, 1958, Vol 121, Nr 5, pp 848 - 849 (USSR)

ABSTRACT:

This paper gives the results of the investigation of the system In-As-Te. In the pseudobinary section InAs-In₂Te₃ of this section solid substitution solutions (tverdyye rastvory zameshcheniya) formed according to the principle of heterovalent isomorphism were observed. As initial material for the synthesis, the following materials were used: 99,995 pure indium, arsenic after a double sublimation in a vacuum, and tellurium after a double sublimation in a vacuum and after a 12-fold purification by zone melting. The authors synthesized 7 compositions of the section InAs-In₂Te₃; the composition of the alloys is given in a table and the experimental conditions are discussed in short. According to the results of the X-ray

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The Solid Solutions in the System $\text{InAs-In}_2\text{Te}_3$

SOV/20-121-5-22/50

analysis, all the samples have the structure of the zinc blende (sphalerite) where the lattice parameter depends linearly on the composition. In this pseudo-binary section, therefore, there are solid substitution solutions in the entire concentration interval. Besides the lines which are characteristic of the structure of the zinc blende type, additional lines were found in the Debye (Debeye) crystallograms of In_2Te_3 . There were no such lines in the investigated solid solutions. The differential thermal analysis was carried out by means of the optical pyrometer developed by Kurnakov. The results of this thermal analysis confirm the results of structural analysis by means of X-rays. The authors found clear critical points for the solidus and for the liquidus, which are characteristic of the diagram of state of solid solutions. A dendrite structure (in addition to a grain structure) was found in some samples. According to the experimental results of this paper, solid solutions are formed in the system $\text{InAs-In}_2\text{Te}_3$.

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The Solid Solutions in the System $\text{InAs-In}_2\text{Te}_3$

SOV/20-121-5-22/50

The investigation of electric properties as a function of composition would be very interesting. Moreover, it is necessary to investigate the photoelectric properties of the alloys. The comparison of the physico-chemical and of the electric properties of such systems may supply some information concerning the mechanism of the processes investigated. The authors thank Professor D.N.Nasledov for his constant interest in this paper. There are 2 figures, 1 table, and 9 references, 5 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk SSSR (Physico-Technical Institute, AS USSR)

PRESENTED: April 18, 1958, by A.F.Ioffe, Academician

SUBMITTED: April 4, 1958
Card 3/3

GORYUNOVA, N.A.; FEDOROVA, N.N.

Solid solutions in the system ZnSe - GaAs. Fiz. tver. tela 1 no.2:
344-345 P '59. (MIRA 12:5)

1. Leningradskiy fiziko-tekhnicheskii institut AN SSSR i Vsesoyuznyy
nauchno-issledovatel'skiy akkumulyatornyy institut pri Gosplane SSSR.
(Solutions, Solid)

GORYUNOVA, N.A.; RADAUTSAN, S.I.; DERYABINA, V.I.

Homogenization of alloys of the system $\text{InAs} - \text{In}_2\text{Se}_3$ by means of annealing under pressure. Fiz. tver. tela 1 no.3:512-514 Mr '59.
(MIRA 12:5)

1. Leningradskiy fiziko-tekhnicheskiy institut AN SSSR.
(Systems (Chemistry))

GORYUNOVA, N.A.; RADAUTSAN, S.I.; KIOSSE, G.A.

New semiconductor compound in the system In - Sb - Te. Fiz.
tver.tela 1 no.12:1858-1860 D '59. (MIRA 13:5)

1. Moldavskiy filial AN SSSR.
(Indium-antimony-tellurium alloys--Electric properties)
(Semiconductors)

GORYUNOVA, A.A.

15(0), 15(2)
478004

Kolomoys, E. T.,
Director of Technical Sciences

The Investigation of Vitreous Semi-Conductors
(Issledeniye stekloobraznykh poluprovodnikov)

SYNOPSIS:
SUMMARY:

From December 1 to 2, 1959 a conference took place on this problem at the Physicochemical Institute of the Academy of Sciences, USSR (Physicochemical Institute of the Academy of Sciences, USSR). It dealt with the discussion of the experiments carried out, mutual information on the course of research and their general coordination. Representatives from 11 scientific institutions attended the conference. The following lectures were heard: V. V. Furecor, Moscow; Khimiko-tekhnologicheskii Institut (Moscow Chemical-technological Institute) spoke of experimental results connected with the investigation of heat capacity at low temperatures of As_2S_3 and As_2Se_3 . His second report dealt with the polymeric concept of glass formation and semiconductors in general.

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E. T. Kolomoys, Gendarmensky Opticheskii Institut (State Optical Institute) emphasized the decisive role played by the covalent bond in glass formation.

A. V. Pechen, Institut Khimii Silikatov Akademii nauk SSSR (Institute of Silicate Chemistry of the AS USSR) described the investigation of the structure of the system $As_2S_3-As_2Se_3$ by X-ray methods.

E. T. Kolomoys, Institut Kristallografi Akademii nauk SSSR (Crystallographical Institute of the AS USSR) reported on the experimental investigation of some chalcogenides by electron-diffraction.

A. I. Gubarev and V. Ya. Kharizgan, Vsesoyuzno-tekhnicheskii Institut (Vsesoyuzno-tekhnicheskii Institut) reported on theoretical problems of the semiconducting properties of glass types.

V. P. Gallo discussed working methods for the determination of boundaries in glass formation in the As_2S_3 and As_2Se_3 systems.

E. A. Goryunova covered the boundaries of vitreous state in As_2S_3 system with the criteria of glass formation obtained by Kharizgan and Vlasov-Klyava and found that there exists no correlation between them.

E. T. Kolomoys investigated the electric properties of semiconducting glass types in the $As_2S_3-As_2Se_3$ system.

E. T. Kolomoys spoke of research work in the field of inner semiconductivity effect done by E. E. Masontova.

E. T. Kolomoys discussed experimental results of the position of the absorption boundary as dependent on the change of composition of glass types.

V. P. Pashayev reported on material he obtained in the investigation of the viscosity of glass types in the $As_2S_3-As_2Se_3$ system.

E. T. Kolomoys summarized the writing results obtained by the Physicochemical Institute and found that in the materials investigated the short-range order is not changed in the transition from the vitreous into the crystalline state.

G. V. Masontova, Leningradskiy Khimiko-tekhnicheskii Institut (Leningrad Chemical-technological Institute) described the investigation of the semiconducting properties of silicate and borosilicate glass types with the addition of iron-nickel and aluminum oxides.

E. T. Kolomoys, Moskovskiy Institut Elektrotekhnicheskogo Staniya (Moscow Institute of Electrotechnical Glass) outlined the investigation results of the boundaries of glass formation and the electric properties of semiconducting glass types of the composition $P_2O_5-P_2O_3-SiO_2$ (A-elements of the X, II, III, IV and V groups of the periodic system).

The next conference on semi-conductor glass types will probably be held in 1959.

6

GORYUNOVA, N. A.

"Some Remarks Concerning the Formation of Semiconducting Tetrahedral Phases."

report presented at the International Conference on Semiconductor Physics,
Prague, 29 Aug - 2 Sep 60.

GORYUNOVA, N.A.

res/

NOTES

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Izd-vo A7 BSSR, 1980.
(Series: ItB: Trudy)

(Series: Ita: 11047)
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Chernomir, K.A. Morozov, V.A.

[illegible]

Piorinskaya, A.K. Yakhtind; Ed. of Publishing House: I.V. Suvorov, Moscow, 1954. 128 p. 12 cm. 1000 copies.

PURPOSE: This book is intended for researchers in the science and technology of polymers. **V.V. Bochever.**

[illegible]

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S/081/62/000/006/013/117
B166/B101

18.9500
AUTHOR:

Goryunova, N. A.

TITLE:

Problems of the formation of semiconductive chemical compounds with a tetrahedral arrangement of atoms in the structure

PERIODICAL:

Referativnyy zhurnal. Khimiya, no. 6, 1962, 36, abstract 6B229 (Izv. Mold. fil. AN SSSR, no. 3(69), 1960, 21-30)

TEXT: The article examines problems of the formation of binary and ternary semiconductor compounds and the chemical bond pattern in these substances. It is suggested that the basis of a tetrahedral structure be the electron lattice formed by tetrahedrally arranged "bridges" made up of paired valence electrons. The formation of tetrahedral structures becomes possible when the value of electron affinity or of the overall group ionization potential exceeds a certain limit and makes the formation of compounds with an ionic metallic bond disadvantageous with respect to energy. It is shown that this condition is fulfilled when the specific electroaffinity constant (the energy of affinity to the ion core of the electron commencing the valence shell) of
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S/081/62/000/006/013/117
B166/B101

Problems of the formation of...

each of the component elements is greater than 7.5 ev. These notions are used as a basis for the possibility of forming compounds $A^{III}B^V$, $A^{II}B^VI$, $A^{I}B^{VII}$, multi-cation compounds $A^{II}B^{IV}C^V$, $A^{I}B^{IV}C^V$, $A^{I}B^{III}C^VI$, $A^{I}B^{IV}C^VI$, $A^{I}B^VC^VI$, multi-anion compounds $A^{III}B^{IV}C^{IV}$, $A^{III}B^{IV}C^{VII}$, $A^{II}B^VC^{VII}$, $A^{II}B^{IV}C^{VII}$, and $A^{II}B^{III}C^{VII}$. [Abstracter's note: Complete translation.]

Card 2/2

S/081/62/000/007/004/033
B156/B101

AUTHORS: Goryunova, N. A., Sokolova, V. I.

TITLE: Complex phosphides

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 7, 1962, 57,
abstract 7B384 (Izv. Mold. fil. AN SSSR, no. 3 (69),
1960, 31-35)

TEXT: Experiments carried out to study the interaction between InP and
various semiconducting compounds are described. [Abstracter's note:
Complete translation.]

Card 1/1

18.7520

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S/137/61/000/011/067/123
A060/A101

AUTHORS: Goryunova, N.A., Sokolova, V.I.

TITLE: Solid solutions in the InP-GaP system

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 11, 1961, 23, abstract
11Zh136 ("Izv. Mold. fil. AN SSSR", 1960, No 3(69), 97 - 98)

TEXT: An investigation was made of three section points of the InP-GaP system: 3InP·GaP, InP·GaP, InP.3GaP. Materials with about 99.999% purity were used to prepare the alloys. The alloys were prepared in evacuated quartz ampoules with vibration stirred heating in a Silit resistor furnace up to 1200°C (3InP·GaP), 1300° (InP·GaP), 1400°C (InP.3GaP) with subsequent rapid cooling. The investigation was carried out by the methods of microscopic and roentgenographic analysis and by measuring the microhardness. It was shown that in the InP-GaP system there exists a continuous series of solid solutions, which are difficult to obtain in the equilibrium state. There are 6 references.

Z. Rogachevskaya

[Abstracter's note: Complete translation]

Card 1/1

S/181/60/002/01/34/035
B008/B014

AUTHORS: Goryunova, N. A., Prochukhan, V. D.

TITLE: Solid Solutions in Quaternary Systems on the Basis of
InAs and InSb

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 1, pp. 176-178

TEXT: The authors studied the formation of solid solutions by a reaction between indium antimonide and arsenide as well as some compounds of the type $A^{II}B^{IV}C_2^V$ having the structure of chalcopyrites. These alloys were synthesized in the usual manner (Ref. 5). They examined alloys in the section $mCdSnAs_2-n(2InAs)$ of the quaternary system Cd-In-Sn-As (Tables 1 and 2) and in the section $mCdSnSb_2-n(2InSb)$ of the quaternary system Cd-In-Sn-Sb (Tables 3 and 4). The system $mCdSnAs_2-n(2InSb)$ was found to have a series of solid solutions throughout the range of concentration.

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Solid Solutions in Quaternary Systems on the
Basis of InAs and InSb

S/181/60/002/01/34/035
B008/B014

Apparently, also the system $mCdSnSb_2-n(2InSb)$ has numerous solid solutions ranging from InSb to a concentration close to the ratio of 1 : 1. Both systems have wide ranges exhibiting the structure of zinc blende. Here, a change in the physicochemical and electric properties can be brought about. There are 4 tables and 10 references, 4 of which are Soviet.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskiy institut AN SSSR
(Leningrad Institute of Physics and Technology, AS USSR)

SUBMITTED: August 7, 1959

Card 2/2

✓B

APPROVED FOR RELEASE: 03/13/2001

CIA-RDP86-00513R000516410013-0

81774

S/181/60/002/02/16/033
B008/B014

54110

AUTHORS:

TITLE:

Goryunova, N. A., Kolomiets, B. T., Shilo, V. P.
Vitreous Semiconductors

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 2, pp. 280-283

TEXT: In investigating binary chalcogenides on the basis of sulfur and selenium it was observed that the elements of the 5th group - phosphorus and arsenic in this case - which have no vitrifying properties when alloyed with selenium and sulfur, easily form glass in a wide concentration range with essential deviations from the stoichiometric ratio. Also alloys of this group (antimony, bismuth) form glass. Chalcogenides of any other element proved to have no vitrifying properties under the experimental conditions of the authors, neither alone nor in alloys. The only exception is germanium. The chalcogenides of the 1st - 4th elements of the 5th group are called vitrifying and those of the 1st - 4th group (with the exception of Ge) non-vitrifying. Vitreous substances were

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Vitreous Semiconductors. 9. Vittrification in
Complex Chalcogenides on the Basis of Arsenic
Sulfide and Selenide

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B006/B067

also obtained by fusing chalcogenides of the elements of the 5th group with chalcogenides of the elements of other groups. Furthermore, the authors investigated the influence exercised in such melts by non-vitrifying chalcogenides on the vitrifying capability of the melt of the two (interacting) chalcogenides. Melts on the basis of arsenic sulfide and selenide were produced with the sulfides and selenides of the elements of the 1st - 4th group (except for B, Al, C, and Si). The syntheses were made in the concentration ranges of ~5 mole% of the ternary systems Me - X - As, where Me is an element of the first four groups, X - sulfur or selenium. The vitrification of the systems As - Se - Me is illustrated by phase diagrams for the elements of the groups I - IV in Figs. 1-4. The sulfides yielded similar results. Figs. 5 and 6 show the experimental results in the form of diagrams which illustrate the ratio between the vitrification ranges of all elements from Cu to Pb. In conclusion, the results are briefly discussed and compared with those of Zachariasen and Winter-Klein. There are 7 figures and 4 references: 3 Soviet and 1 American.

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Vitreous Semiconductors. 9. Vitrification in
Complex Chalcogenides on the Basis of Arsenic
Sulfide and Selenide

S/181/60/002/02/16/033
B006/B067

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR Leningrad
(Physicotechnical Institute of the AS USSR, Leningrad)

SUBMITTED: May 13, 1959

Card 3/3

24.7500

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S/181/60/002/02/17/033
B006/B067

AUTHORS: Baranov, B. V., Goryunova, N. A.

TITLE: Preparation of Homogeneous Solid Solutions in the System
AlSb - InSb

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 2, pp. 284-287

TEXT: On their search for new semiconducting materials with optimum electrical parameters the authors report on investigations of solid solutions of the system AlSb-InSb; the first component shows a considerable width of the forbidden band, the second one high carrier mobility. The first experiments showed that no homogeneous solid solutions of this system could be obtained by ordinary methods. The results of attempts of homogenizing the alloys are discussed in the following. Table 1 indicates the purity of the initial substances. The alloys were synthesized in closed graphite crucibles which had been boiled in concentrated nitric acid, washed in distilled water, and heated at 1100°C. The crucibles with the substance were put into quartz ampoules filled with spectrally pure argon, heated up to 1100°C, and then slowly cooled in

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Preparation of Homogeneous Solid Solutions
in the System AlSb - InSb

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B006/B067

the furnace. The alloy obtained was coarsely crystalline (Fig. 2), and the X-ray pictures showed broad bands corresponding to the nonequilibrium solid solution. After a tempering for 120 to 500-700 hours between 540 and 600°C small dark crystals were observed (Figs. 5, 6), and the X-ray pictures showed line systems indicating a change in the lattice parameters (Fig. 8, Table 2). Heating above 600°C led to volatilization of antimony, a prolonged heating did not improve the homogenization. Further investigations showed that the microhardness of the visible crystal deviated essentially from the microhardness of the two components (e.g., 800 kg/mm² - AlSb: 420, InSb: 220 kg/mm²). The authors explain this by the fact that the presence of an eutectic in the alloys is connected with the formation of aluminum carbide. The homogeneous solid solutions obtained also showed higher corrosion resistance. In contrast to the non-homogenized samples which easily decompose in air or water, the homogenized samples were not affected by air and water even over a longer period. Also a treatment with 0.01 N HCl for 500 hours did not etch the surface of the homogenized samples; 0.1 N HCl had no noteworthy influence on corrosion resistance. Hence, the authors succeeded in

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Preparation of Homogeneous Solid Solutions
in the System AlSb - InSb

S/181/60/002/02/17/033
B006/B067

obtaining solid solutions by tempering with subsequent cooling at a temperature which was much higher than the melting point of the most easily meltable component. In conclusion, the authors thank Professor D. N. Nasledov for discussions and his interest in this work. There are 10 figures, 2 tables, and 9 references: 3 Soviet, 5 German, and 1 British.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR Leningrad
(Physicotechnical Institute of the AS USSR, Leningrad)

SUBMITTED: May 13, 1959

Card 3/3

X

20616

S/063/60/005/005/005/021
A051/A029

24-7700 1043, 1136, 1151, 1150

AUTHOR: Goryunova, N.A., Doctor of Physical Sciences

TITLE: The Chemistry of Diamond-Like Semiconductors

PERIODICAL: Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva im. D.I. Mendeleeva, 1960, No. 5, Vol. 5, pp. 522-534

TEXT: The author discusses the nature of binary compounds with a structure of zinc blende, i.e., analogues of diamond silicon, germanium, gray tin, discovered only recently (Ref. 3). It is known today that simple and complex substances, which crystallize in diamond, zinc blende, wurtzite structures or close to these (e.g., chalcopyrite), are considered to be semiconductors and are combined into one crystalline group (Ref. 4,5). It is also established that tetrahedric covalent bonds create the most favorable conditions for electron transfer. It is pointed out that substances of the crystallo-chemical group have a great future for their application in radio-electronics. A^{III}B^V-type compounds are applied in the semiconductor industry because they are the closest analogues of semiconductor elements of the IV group of the

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The Chemistry of Diamond-Like Semiconductors

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A051/A029

periodic system of elements. The latter group is known to have a series of physico-chemical properties and electrical parameters other than those established in diamond, silicon, germanium and gray tin. Special mention is made of the solid solutions InSb-GaSb which were first investigated in the Soviet Union (Ref. 9,10). The author stresses the fact that intensive search for new semiconductor materials is going on all over the world. One aspect of this search is the determination of the possibility for producing semiconductors based on complex multi-component substances of the crystallo-chemical group diamond-gray tin. Difficulties encountered in this respect are in the production of highly pure and single crystal substances. The author lists and comments on the works of various Soviet and foreign authors with respect to the following subjects: the formation of substances with a sphalerite and wurtzite structure, physico-chemical properties, production of initial and binary materials, electrical properties, bond type and property changes, solid solutions and new semiconductors. Goldschmidt synthesized many compounds with a diamond structure. Table 1 lists part of the periodic table where a frame is placed around the elements yielding binary compounds with a tetrahedric distribution of the atoms in the structure, with at least one of the elements equidistant from the IV group of elements. Table 2

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The Chemistry of Diamond-Like Semiconductors

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A051/A029

lists the structural types formed by compounds of the elements in Table 1, and accepted at the present time as the symbols of compound types. The bond model of the diamond is taken for interpreting the properties of the given group (Ref. 4, 16-19). It is stated that the binary compounds included in the crystallo-chemical group under discussion are similar to each other in their physico-chemical properties. Properties typical for the entire group are best expressed in the $A^{III}B^V$ group of compounds, closest in the location of their component atoms. All these substances have a low solubility in water, most of them are stable to oxygen and air moisture (excepting aluminum compounds). All the substances are derivatives of hydrogen acids and form the latter when decomposed. In most cases they are the only compounds which form in the given systems. Thus, the $A^{III}B^V$ compounds are given special attention in this article as being only relatively recently discovered as compared to the $A^{II}B^VI$ and A^IB^VII groups. Several phase diagrams are presented in Fig. 1-7 and are seen to be of the same type. Regardless of the noticeable dissociation in almost all the compounds investigated from this stand point there was a noticeable tendency to form during solidification compounds with a stoichiometric composition. In order to solve the problem of the width of the homogeneity region in the compounds of the

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A^{III}B^V type, a large number of methods must be applied. An X-ray analysis of indium phosphide and gallium arsenide did not indicate the existence of a noticeable region of homogeneity near the stoichiometric composition (Ref. 31, 32). Table 3 is a list of the main physico-chemical properties of the A^{III}B^V type compounds taken from the literature (Ref. 13, 16, 33-41). It was found that with an increase in the temperature the coordination number increased, coming closer at certain temperatures to a dense packing (Ref. 46). The A^IB^{VI} type was found to behave in a different manner in the molten state, showing a tendency to the formation of molecular structures (Ref. 42). For most of the substances of the A^{III}B^V type the chemism and the kinetics of the action of various reagents have not been studied. In etching, the etching agent has to be selected by experimental means (Ref. 16, 51). Some of the characteristics of the latter group which have not been thoroughly investigated are the Debaye temperature thermal conductivity, heat of formation, etc. Compounds with a sphalerite structure, both of the A^{II}B^{VI} and A^{III}B^V type, catalyze oxidation-reduction reactions (Ref. 56). Germanium was discovered during the last war as semiconductor, the unusual properties of which could be detected only after a super-fine purification and obtaining

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a single crystal. At present the analogues of Ge and Si are gradually introduced into the semiconductor industry, also binary and more complex alloys with a zinc blende structure. The future prospects of applying the latter in the semiconductor industry is also determined by the degree of purification and perfection of the crystals, thus the problem of their production is connected with the purification of the initial materials. The processes of precipitation, admixture extraction with solvent, vacuum fractionating distillation and thermal dissociation are used for this purpose (Ref. 57-59). The method of fractionating recrystallization is used for the metallic components of semiconductor compounds of this group and also for the semiconductor materials of the Al_3B_2V type. In order to obtain single crystals, Chokhralskiy's method is used. These processes are based on the application of the difference in the compositions of the contacting solid and liquid phases of the substance in crystallization and displacing the admixtures from the crystallization front. Actually, the substances are subjected to repeated zonal recrystallization and the single crystals are drawn out of the purified melt. The distribution coefficient of the admixtures (K) plays the most important part in the purification process, which characterizes the ratio of the admixture content in the solid phase to the admixture

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content in the liquid contacting it. When K is less than 1, the purification is very effective. In the case where the chemical nature of the admixture is close to that of the main substance, K is equal to 1 and the purification by the above-mentioned methods becomes rather difficult. The technology of the binary semiconductors (especially antimonides) is mostly similar to that of Ge. However, due to the volatility of the non-metallic components, arsenides and phosphides, the methods of their production and purification are somewhat changed from the other, in order to eliminate the harmful effect of the evaporation of the arsenic and phosphorus. An improved method has been suggested (Ref. 66) based on the independent regulating of the vapor pressures of the volatile component. Fig. 8 shows the method of the zonal recrystallization, successfully used by the author for purifying gallium arsenide. In Ref. 67, the method of zonal recrystallization without crucible in a sealed vessel is described. Several other methods of synthesizing binary semiconductors of the diamond group are mentioned, where the purification of the material can be accomplished by purifying the initial components. These methods have only a limited significance (Ref. 15, 70). The mechanical processing of the obtained compounds is similar to that of silicon and Ge: the samples can be sawed, polished and ground. Precautions

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must be taken against dust-like particles by using protective glasses, plexiglas hoods and rubber gloves. The author mentions the many works published on the electrical properties of the A^{III}B^V type semiconductors and outlines the special demands placed on these from the electrical standpoint: the width of the forbidden zone, distribution, concentration and degree of ionization of the admixtures, the value of the effective masses, mobility of the charge carriers, life-span of the electron-hole pairs and diffusion length of the shift, nature and activity of the centers of capture and recombination (Ref. 76). The A^{III}B^V type of semiconductors present an interesting material for use as rectifiers, photocells, Hall emf transmitters, etc. Certain compounds of the mentioned type can be successfully used in thermoelectrical generators (Ref. 77). The work of most semiconductor instruments is ensured through the admixture mechanism of conductivity. The role of the admixtures can be played not only by the foreign atoms, but also by atoms included in the composition of compounds with a super-stoichiometric ratio and destruction of the crystal lattice. The principle of action of the "ideal" semiconductor of the diamond type is simple, based on the action of the foreign admixtures introduced by the replacement mechanism. If the atom has a valency greater than the atom of the main lattice, then the extra

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valency electron of the atom can take part in the transfer of electricity, forming an electronic conductivity of the substance. In studying the activity of admixtures in the $A^{III}B^V$ compounds, a certain analogy with the behavior of admixtures in Ge and Si was noted (Ref. 31, 78-82). In binary semiconductors of the $A^{III}B^V$ type elements of the second group (zinc, cadmium) usually act as acceptors, forming a hole conductivity, and elements of the fourth group (sulfur, selenium, tellurium) act as donors, determining the electronic conductivity. The physical basis for the use of most semiconductors of this group are the electronic processes which occur in this transition range. Indium antimonide brought to a state of super-purity is used as an "ideal" semiconductor today for the quantitative check of the theory and the production of numerous electronic semiconductor instruments. The characteristic feature of these compounds is the high mobility of the electrons, the relatively low mobility of the holes and the low effective mass of the charge carriers. These features are the cause of certain previously unknown phenomena in the $A^{III}B^V$ type compounds, such as anomaly of the optical absorption (Ref. 83), a weak dependence of the Hall effect and electroconductivity on the temperature in the region of low temperatures (Ref. 84), negative change of the resistance in a magnetic field (Ref. 85),

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A051/A029

etc. The actual application of the Hall effect in instruments became possible with the discovery of semiconductors having a very high mobility of the electrons. Indium antimonide and indium arsenide are the substances with the greatest future as materials to be used in infra-red detectors, and indium phosphide as a material for rectifiers and amplifiers (Ref.75). Gallium arsenide shows the greatest promise as a material for solar batteries, more so than silicon (Ref.88,89). Gallium arsenide and aluminum antimonide will be used for rectifiers (Ref.57,75). Table 4 shows the main electrical properties of the compounds of the A^{III}B^V type according to Ref.74, 75, 90. Gallium phosphide is very suitable for rectifiers working at high temperatures. Boron compounds are expected to have the same advantages compared to silicon carbide, as gallium arsenide has by comparison to Ge. As regards the type of chemical bond in the crystallo-chemical diamond group, the author notes the following two main rules: a) in the analogue compound series, b) in the isoelectron series. In the first case with an increase in the atomic weight within the same group of the periodic system, the bond type should change toward the direction of strengthening the "metallization". In the second case the change in the bond type should be connected with an increase in the distance between the elements in the periodic table, which

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compose the substances, or, i.e., with an increase in the difference of the chemical nature of the atoms. Table 5 lists some of the physico-chemical and electrical characteristics of the substances of the isoelectronic series of germanium and gray tin (Ref. 74, 16). From the table it is seen that an intensification of the ionic state causes a drop in the hardness described by Goldschmidt (Ref. 13). This was noted as a weakening of the inter-particle bond. The melting temperature in the isoelectronic series changes in a complex way, explained by the fact that the melting of the A^{IV} substances, of the $A^{III}B^V$ and the $A^{III}B^{VI}$ compounds are processes which are not analogous, i.e., the degree of destruction of the bonds and their transformation into another shape is different for these substances. The direct proof of the presence of ions in the compounds of the $A^{III}B^V$ and $A^{III}B^{VI}$ types is taken to be the determination of cleavage. The presence of ionic and covalent bonds in the substances of the $A^{III}B^V$ type was proven by a number of other methods given in Ref. 95, 96. The observed rules in the change of the properties concomitant with a change in the bond type in a number of analogue compounds and in the iso-electronic series have served as the basis for reliably determining the properties of the substances which are still only slightly investigated. The compounds of the $A^{III}B^V$ type are the closest

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analogues to diamonds, silicon, germanium and gray tin, amongst all the members of the crystallo-chemical group. Several references are mentioned which deal with the investigations of several solid solutions, formed by silicon and germanium (Ref. 97), and the technological developments of materials suitable for use in instruments (Ref. 100). It has been assumed that the analogy of the $A^{III}B^V$ compounds and the elements of the fourth group is extended to the nature of their interaction as well. Thus, investigations were carried out of pseudo-binary sections of the ternary systems of the InSb-GaSb, InAs-GaAs types, etc. All the investigated compounds of the $A^{III}B^V$ type, when reacting with each other, have shown a certain solubility. The interaction with the formation of continuous solid substitution solutions was particularly easy in the systems InP-InAs and GaP-GaAs. Fig. 10-12 are a few other structural diagrams investigated. The difficulties encountered by the diffusion of the solid solutions in substances with a covalent bond were connected with the direction of the covalent bond, presenting additional limitations on the mutual distribution of the atoms and serving as an obstacle to diffusion (Ref. 16). All the diagrams shown in Fig. 10-12 were taken after the homogenization of the alloys in the solid state. The results of the thermal analysis of the indicated ternary systems serve as an example of the usefulness of the physico-chemical analysis in semiconductors.

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A051/A029

An interesting property of the solid solutions based on AlSb is their stability to oxygen and air moisture exceeding that of aluminum antimonide (Ref. 105,106). It has been shown that a considerable increase in the effectiveness of thermo-elements can be attained if materials are used, which are based on multi-component solid solutions, since the latter have a lesser thermal conductivity compared to compounds included in their composition. Some data available point to the application of the solid solutions of the InAs-InP system for this purpose. With respect to new types of semiconductors the author mentions also the defective binary compounds of the $A^{III}_2B^{VI}_3$ type discovered in 1949 (Ref. 117). Their structure is defective with respect to the metal atoms. In their electrical properties they were found to be semiconductors with properties which are intermediary compared to the properties of the compounds of the $A^{III}B^V$ and $A^{II}B^{VI}$ types (Ref. 116,119). However, the mobility of the charge carriers in these new substances was found to be very low. Some of the compounds of this type form solid substitution solutions with one another, as well as by the interaction with substances of the $A^{III}B^V$ type (Ref. 118, 124-130). The defective compounds of the $A^{III}_2B^{VI}_3$ type, when interacting with substances of the $A^{II}B^{VI}$ type, formed homogeneous semiconductor substances, chemical compounds and solid substitution solutions (Ref. 134-135). It is assumed that in all semiconductor

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alloys based on defective compounds of the $A_2^{III}B_3^{VI}$ type and in the investigated ones, the mobility will be only slight due to the statistical distribution of the empty places in the lattice. Non-defective ternary compounds with diamond-like structures are of greater interest in the search for new combinations of properties close to that of germanium and silicon. It is further assumed that the binary and ternary compounds represent all the possibilities of chemical compounds with a diamond-like structure. The author points out in conclusion that the number of possible materials with semiconductor properties, which are analogues of diamond, is continuously increasing since the possibilities are unlimited for their production and that they are not limited only to the chemical-crystalline group of diamond-like semiconductors. There are 5 tables, 12 figures, 1 diagram and 149 references: 86 are Soviet, 36 are English, 22 German, 2 Czech, 1 Dutch, 2 unidentified. (X)

Card 13/24

GORYUNOVA, N.A.

Bond type and properties of the semiconductor crystallochemical group
diamond - zinc blende - wurtzite. Probl. kin. i kat. 10:96-101 '60.
(MIRA 14:5)

1. Fiziko-tekhnicheskiy institut AN SSSR.
(Diamond) (Sphalerite) (Wurtzite)

82563

S/080/60/033/06/04/006

5.2610

AUTHORS: Goryunova, N. A., Kradinova, L. V., Sokolova, V. I., Sokolova, Ye.V.

TITLE: A Method of Obtaining High-Purity Arsenic ¹

PERIODICAL: Zhurnal prikladnoy khimii, 1960, Vol. 33, No. 6, pp. 1409-1410

TEXT: Gallium arsenide GaAs is a semiconductor material with a rectifying effect and photoconductivity. Arsenic is usually accompanied by antimony and bismuth which have similar physical and chemical properties, so that their separation from arsenic is difficult. Arsenic trioxide was taken as initial material, therefore, because it does not contain bismuth and only small quantities of Sb, Cu, Al, Ca, Fe, Si and Mn. The purification was carried out in two stages: purification of arsenic trioxide; reduction of the trioxide to arsenic metal. The trioxide was purified by recrystallization from a hydrochloric solution. After complete dissolution of As_2O_3 the hot solution was filtered and then kept for 20-24 hours in a cold place. The crystals formed were reduced by activated coal in a quartz ampoule. The arsenic metal was distilled in a 10^{-3} mm Hg vacuum. At $300^\circ C$ the fraction containing As_2O_3 and at $450^\circ C$ pure arsenic was distilled. On the base of arsenic produced ² by the method proposed, GaAs can be obtained with a concentration of charge carriers

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82563

A Method of Obtaining High-Purity Arsenic

S/080/60/033/06/04/006

$n \approx 10^{16} \text{ cm}^{-3}$. Further treatment by zone melting and extraction of single crystals produces a material suitable for the application as semiconductor. There is 1 table and 7 references: 2 Soviet, 3 German, 1 English and 1 French.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskii institut AN SSSR (Leningrad
Physico-Technical Institute of AS USSR)

SUBMITTED: June 25, 1958
February 4, 1960 (after revision)

Card 2/2

GORYUNOVA, N.A.

Some problems involved in the formation of complex tetrahedral phases.
Vest.LGU 16 no.10;112-124 '61. (MIRA 14:5)
(Semiconductors) (Germanium compounds)

GORYUNOVA, N.A.; ORLOVA, G.M.; DANILOV, A.V.; ABRAMOVA, A.V.; PLECHKO, R.L.;
KOZHINA, I.I.

Some quaternary analogs of germanium. Vest LGU 16 no.22:97-101
'61. (MIRA 14:11)
(Germanium alloys) (Semiconductors)

S/081/62/000/011/007/057
E111/E152

AUTHORS: Goryunova, N.A., Vaypolin, A.A., and Chiang-ping-hsi
TITLE: Solubility of germanium in some ternary compounds
with a tetrahedral structure

PERIODICAL: Referativnyy zhurnal, Khimiya, no.11, 1962, 51,
abstract 11 B 292. (In the Symposium: 'Fizika i
khimiya' ('Physics and Chemistry'), L., 1961, 26-29)

TEXT: Using the X-ray structural method the solution of Ge
in CuGe_2P_3 (I), which has a tetrahedral arrangement of atoms, was
studied. It was shown that in I the most probable disordered
arrangement of atoms of Cu and Ge is in positions similar to those
of the metal in the sphalerite structure, and of P atoms in
positions of the non-metal in the same structure. When solid
solutions were formed in alloys of the homogeneous range from the
composition of I to that of the alloy with the composition
70 mol % I the X-ray patterns showed one system of sharp lines
corresponding to the structure of ZnS . The period of identity
varied from a 5.38 kX for I to 5.48 kX for the alloy with the
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↓

Solubility of germanium in some ... S/081/62/000/011/007/057
E111/E152

limiting concentration. When Ge dissolves in I its atoms
occupy both "cationic" and "anionic" positions.

[Abstractor's note: Complete translation.]

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34708

S/137/62/000/002/053/14
A006/A101

18.7500

AUTHOR: Goryunova, N. A.

TITLE: Semi-conductor A^{III}B^V type compounds and the nature of their interaction with other substances

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 2, 1962, 36-37, abstract 2G289 (V sb. "Vopr. metallurgii i fiz. poluprovodnikov", Moscow, AN SSSR, 1961, 123-126)

TEXT: The author analyzes the problem on the formation of compounds or solid solutions between A^{III}B^V type compounds and other compounds. Alloys of ternary systems of the following types were studied: A₁^{III} - B₂^{III} - B^V and A^{III} - B₁ - B₂. It was assumed that in these systems interaction takes place together with the formation of solid solutions over pseudo-binary sections A₁^{III}B^V - A₂^{III}B^V and A^{III}B₁ - A^{III}B₂. Experimental data accumulated show that in this case there are regions of solid solution formation which are more or less extended over the pseudo-binary section (depending on the proximity of substitution components), and always very narrow in respect to excessive elementary components. Data on the formation of solid solutions between A^{III}B^V

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Semi-conductor A^{III}₂B^V type compounds ...

S/137/62/000/002/053/144
A006/A101

compounds indicate that this process is not uniform in different systems. The difficult formation of solid solutions which can be considered as a common phenomenon for the A^{III}₂B^V - A^{III}₂B^V systems is apparently connected with the fact that in substances with a covalent bond type, diffusion in solid state proceeds at much lesser speeds than in alloys with another type of electronic interaction. It was established that in A^{III}₂B^V - A^{III}₂B^V systems, in the majority of cases, the zone of homogeneous alloys corresponds actually to the pseudo-binary sections. The author investigated also the interaction of A^{III}₂B^V with A^{III}₂B^{VI} type compounds. It was established that the formation of solid solutions³ in the system with the participation of antimonides proceeds in a relatively narrow concentration range. Solid solutions are developed also in a wide concentration range at an interaction of A^{III}₂B^V with the A^I₂B^{IV}₂C^V₃ type compounds. A new compound, CuGeAsSe, was obtained with the ZnS structure; 5.53 Å identity period, 658°C melting point, and about 560 kg/mm² microhardness.

B. Golovin

[Abstracter's note: Complete translation]

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30866
S/054/61/000/004/007/009
B102/B138

24,7300(1153,1160,1454)

AUTHORS: Goryunova, N. A., Orlova, G. M., Danilov, A. V., Abramova,
A. V., Plechko, R. L., Kozhina, I. I.

TITLE: Some quaternary analogs of germanium

PERIODICAL: Leningrad. Universitet. Vestnik. Seriya fiziki i khimii,
no. 4, 1961, 97 - 101

TEXT: Of the possible quaternary analogs of germanium which form tetra-
hedral phases, only the system ZnSe-GaAs has so far been investigated. +
The authors chose the system Cu-Ge-As-Se which has a tetrahedral phase
of variable composition in the section $\text{Cu}_2\text{GeSe}_3\text{-CuGe}_2\text{As}_3$. The presence of
this phase was verified and the physical and chemical properties of the
phases were studied. 17 alloys from the above section were synthesized
by fusion of the components in evacuated quartz ampoules at 750°C .
Microstructure of the alloys was determined by means of an МММ-7 (MIM-7)
microscope and microhardness with a ПМТ-3 (PMT-3) tester. Thermographic
analyses were carried out with normal as well as differential recording.
X-ray structural analyses showed that the alloys ranging from 2.0
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B102/B138

Some quaternary analogs of...

$\text{Cu}_2\text{GeSe}_3 \cdot \text{CuGe}_2\text{As}_3$ to $4.0 \text{ Cu}_2\text{GeSe}_3 \cdot \text{CuGe}_2\text{As}_3$ were single-phase. The composition $1.5 \text{ Cu}_2\text{GeSe}_3 \cdot \text{CuGe}_2\text{As}_3$ contained two phases and $\text{Cu}_2\text{GeSe}_3 \cdot 0.4 \text{ CuGe}_2\text{As}_3$ three. The inhomogeneity increased with the As concentration of the composition. All alloys contained a sphalerite-type structure with lattice constant $a = 5.54 \pm 0.01 \text{ kX}$. A composition $m:n = 1.6:1.0 - 4.0:1.0$ gave single-phase alloys; ($m = \text{Cu}_2\text{GeSe}_3$, $n = \text{CuGe}_2\text{Se}_3$), $m:n = 1.0:2.0$; 3.0 ; 4.0 contained an additional phase with $a = 5.20 \pm 0.01 \text{ kX}$; $m:n = 5.0:1.0$; $4.5:1.0$; $1.5:1.0$; $1.2:1.0$; $1.0:1.0$ contained, apart from the common one, another sphaleritic phase with $a = 4.41 \pm 0.01 \text{ kX}$. The second ZnS-type phase was separated by zone melting of $\text{Cu}_2\text{GeSe}_3 \cdot \text{CuGe}_2\text{As}_3$ with an optimum rate of $0.5 - 1.5 \text{ cm/hr}$ and 7 - 10 cycles. In the transition from the ternary Cu_2GeSe_3 to the quaternary As-containing system, from 83.3 mole% $m + 16.7 \text{ mole\% } n$ the distorted chalcopyrite lattice is rearranged into the regular ZnS lattice. Lattice parameter and microhardness are not sensitive to composition. The homogeneous region of composition ranges from $\text{Cu}_5\text{Ge}_4\text{As}_3\text{Se}_6$ to

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30866

S/054/61/000/004/007/009

B102/B138

Some quaternary analogs of...

$\text{Cu}_9\text{Ge}_6\text{As}_3\text{Se}_{12}$. These materials might give a new combination of semiconductor parameters. There are 1 figure, 5 tables, and 10 references: 7 Soviet and 3 non-Soviet. The two references to English-language publications read as follows: C. H. L. Goodman. Nature 179, 828, 1957; J. Phys. and Chem. Solids, 6, 36, 1958.

4

Card 3/3

KOZHINA, I.I.; TOLKACHEV, S.I.S.; BORSHCHEVSKIY, A.S.; GORYUNOVA, N.A.

Study of the GaAs - Ga₂S₃ system. Vest.LGU 17 no.4:122-127 '62.
(MIRA 15:3)

(Gallium arsenide)(Gallium sulfide)

S/137/61/000/010/020/056
A006/A101

AUTHORS: Goryunova, N.A., Averkiyeva, G.K., Sharavskiy, P.V., Tovpentsev, Yu.K.

TITLE: Investigation of quaternary alloys based on indium antimonide and cadmium telluride

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 10, 1961, 44, abstract 10G344 (V sb. "Fizika i khimiya", Leningrad, 1961, 22 - 25)

TEXT: The authors present brief information on investigating a pseudo-binary section CdTe-InSb of the quaternary Cd-Te-In-Sb system. The alloys investigated were prepared by direct fusion of the initial materials in evacuated quartz ampoules and were subjected to metallographical analysis. Simultaneously microhardness was determined. It was established that in the range of 95-100% InSb concentration there is a homogeneous area with ZnS structure. In the other points of the system two phases were revealed whose microhardness exceeds that of the initial components - CdTe and InSb.

A. Nashel'skiy

[Abstracter's note: Complete translation]

Card 1/1

GORJUNOVA, N.A.; VOYTSEKHOVSKIY, A.V.; PROCHUKHAN, V.D.

Possibility of forming solid solutions in some four-component systems.
Vest.LGU, no.10:156-158 '61. (MIRA 14:5)
(Solutions, Solid)

35350

S/054/62/000/001/008/011
B121/B138

26.2420
AUTHORS:

Kozhina, I. I., Tolkachev, S. S., Borshchevskiy, A. S.,
Goryunova, N. A.

TITLE:

Examination of the system $GaAs - Ga_2S_3$

PERIODICAL:

Leningrad. Universitet. Vestnik. Seriya fiziki i khimii,
no.1, 1962, 122-127

TEXT: To study the interactions thoroughly, the intermediate stages were examined by X-ray, thermal, and microstructural analyses. The alloys were produced by direct fusion of gallium, arsenic, and sulfur in evacuated quartz ampoules between 1280 and 1300°C. Homogenization of the alloys was reached by annealing the samples at 900°C in evacuated quartz ampoules in a ППК-2 (РПК-2) crucible furnace. X-ray structural analyses were conducted in a ППК-2 (РПК-2) chamber 57.3 mm in diameter by the asymmetrical method. The microhardness of the alloys was determined with a ПМТ-3 (PMT-3) device. An ППК-55 (РПК-55) device was used for differential thermal analysis. Altogether 17 alloys of varying compositions were studied in the section $Ga_3As_3 - Ga_2S_3$. Their coloring changed from gray with a metallic luster

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S/070/62/007/006/004/020
E073/E335

AUTHORS: Ozolin'sh, G.V., Averkiyeva, G.K., Iyevin'sh, A.F.
and Goryunova, N.A.

TITLE: X-ray diffraction investigations of some A^3B^3 -type
compounds with compositions deviating from the
stoichiometric

PERIODICAL: Kristallografiya, v. 7, no. 6, 1962, 850 - 853

TEXT: The aim of the investigations was to determine the
width of the concentration range in which indium and gallium
arsenide, made from 99.98% purity materials, remained homogeneous.
The specimens were synthesised in evacuated quartz ampules with the
following sequence of operations: slow heating to 650 °C for 3 h;
holding at this temperature for 2 hours; slow heating to 100 °C
above the fusion temperature of the compound and holding for
30 min; cooling together with the furnace for 12 - 14 hours.
Specimens of stoichiometric and non-stoichiometric composition
were synthesised. The substance was broken-up into powder prior
to taking the X-ray diffraction pictures and annealed in evacuated
quartz ampules for 5 hours at 350 °C. Results: within the errors
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X-ray diffraction

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E075/E335

of determination (0.0001 Å) the lattice spacings did not depend on the excess of one or the other compound with respect to stoichiometry. Without correcting for refraction, the following values were obtained for +25 °C:

InAs: $a = 6.05838 \pm 0.00005 \text{ Å}$
GaAs: $a = 5.65515 \pm 0.00010 \text{ Å}$

There are 2 tables.

ASSOCIATION: Institut khimi AN LatvSSR (Institute of Chemistry of the AS Latvian SSR)
Fiziko-tekhnicheskiiy institut AN SSSR (Physico-technical Institute of the AS USSR)

SUBMITTED: December 8, 1961

Card 2/2

24.7700 (1043, 1137, 1138)

34753

S/020/62/142/003/020/027
B101/B110

AUTHORS: Goryunova, N. A., Mamayev, S., and Prochukhan, V. D.

TITLE: Some properties of the semiconductor CdSnAs_2 , an electronic analog of indium arsenide

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 142, no. 3, 1962, 623-626

TEXT: On the basis of data for the width of the forbidden band and the microhardness it was concluded that the chemical bond was more covalent in CdSnAs_2 than in InAs (InAs: $\Delta E = 0.45$ ev, $H = 330$ kg/mm²; CdSnAs_2 : $\Delta E = 0.26$ ev, $H = 395$ kg/mm²). Hence follows a higher mobility of current carriers in CdSnAs_2 as compared with InAs. An improved method of synthesizing CdSnAs_2 was used to prove these assumptions. [Abstracter's note: Method not stated.] The authors obtained monolithic, polycrystalline specimens (grain size: a few millimeters) as well as single crystals (a few centimeters long) of a cross section of ~ 0.25 cm². Their homogeneity was confirmed by the constant microhardness and electrical conductivity, as well as by the Debye-Scherrer patterns, the homogeneous

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S/020/62/142/003/020/027

Some properties of the semiconductor... B101/B110

structure of single crystals was confirmed by Laue diffraction patterns. The melting point was 615°C . The Hall effect R (at 6700 oersteds) and the electrical conductivity σ were measured between 77 and 840°K . The following was found: (1) σ is independent of temperature in the range of 77 - 280°K . With increasing temperature, σ passes a minimum and then rises, following an exponential function. The minimum for an inhomogeneous polycrystal (A) was at 550°K , for a monolithic polycrystal (B) at 370°K , and for a single crystal (C) at 365°K . (2) At room temperature, σ was $2.5 \cdot 10^2 \text{ ohm}^{-1} \cdot \text{cm}^{-1}$ for A, $3.4 \cdot 10^2$ for B, and $4.1 - 3.1 \cdot 10^2$ for C. (3) The mobility n of current carriers ($n = R\sigma$) was (in $\text{cm}^2/\text{v} \cdot \text{sec}$): 1000 for A, 5800 for B, and 18,000 - 22,000 for C. (4) The sign of Hall coefficient and thermo-emf showed electronic conductivity for all specimens. (5) Accordingly, the compound CdSnAs_2 is a semiconductor with higher n values than in any known ternary compound; the n values are even a little higher than for InAs . The n value for CdSnAs_2 is reduced by impurities; it can be elevated by improved purification. CdSnAs_2 offers good prospects for practical use as semiconductor. D. N. Masledov is thanked

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Some properties of the semiconductor...

S/020/62/142/003/020/027
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for a discussion. There are 3 figures, 2 tables, and 6 references: 2 Soviet and 4 non-Soviet. The three references to English-language publications read as follows: C. H. L. Goodman, Nature, 179, 828 (1957); A. J. Strauss, A. J. Rosenberg, J. Phys. Chem., Sol., 17, 289 (1961); H. Pfister, Acta Crystallogr., 11, 221 (1958).

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe Akademii nauk SSSR (Physicotechnical Institute imeni A. F. Ioffe of the Academy of Sciences USSR)

PRESENTED: September 2, 1961, by A. N. Frumkin, Academician

SUBMITTED: September 30, 1961

Card 3/3

S/137/62/000/011/019/045
A052/A101

AUTHORS: Goryunova, N. A., Grigor'yeva, V. S., Sharavskiy, P. V.
Osnach, L. A.

TITLE: Solid solutions in the InAs-HgTe system

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 11, 1962, 17 - 18,
abstract 111132 (In collection: "Fizika". Leningrad, 1962, 7 - 10)

TEXT: The possibility of the solid solution formation according to the type of heterovalence substitution on the base of semiconducting compounds InAs and HgTe was studied. The boundaries of the phase homogeneity were determined. 9 alloys of the quasibinary cross section of InAs-HgTe were investigated in intervals of 15% by composition. The alloys were prepared from 99.99% pure initial material fused in evacuated quartz ampoules, diffusion-annealed at 570 - 600°C during 550 - 600 hours and investigated microscopically and partly by means of thermal and X-ray analyses and by measuring microhardness. In the InAs-HgTe system, formation of a continuous series of solid solutions was established in a wide concentration range with a Zn-blende structure and a lattice parameter varying by linear law in transition from InAs ($a=6.04$ kX) to HgTe ($a=6.46$ kX).
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Solid solutions in the InAs-HgTe system

S/137/62/000/011/019/045
A052/A101

There are 12 references.

Z. Rogachevskaya

[Abstracter's note: Complete translation]

Card 2/2

GORJUNOVA, Nina Aleksandrovna; PIASTRO, V.D., red.; YELIZAROVA,
N.A., tekhn. red.

[Adamantine semiconductor chemistry] Khimiiaalmazopodob-
nykh poluprovodnikov. Leningrad, Izd-vo Leningr. univ.,
1963. 221 p. (Semiconductors) (MIRA 16:6)

S/137/62/000/011/017/045
A052/A101

AUTHORS: Goryunova, N. A., Takhtareva, N. K.

TITLE: Solid solution formation between indium antimonide and arsenide

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 11, 1962, 17,
abstract 111130 (Izv. AN MoldSSR", no. 10 (88), 1961, 89 - 90)

TEXT: InAs-InSb alloys after hardening from a fused state (1050 - 1100°C) in an aqueous NaCl solution were annealed at 540 - 570°C depending on the composition during 300, 550 and 700 hours. Conclusions are drawn on the existence of solid solutions in the whole range of concentrations and on an easier solubility of InSb in InAs.

V. Srednegorska

[Abstracter's note: Complete translation]

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15
Physico-chemical properties and structure of monocrystalline samples of ZnSiAs_2 . A. A. Vaypolin, N. A. Goryunova, E. O. Osmanov.

Investigation of macrocrystalline ZnSiP_2 . N. A. Goryunova, A. A. Vaypolin, Yu. V. Rud'.
 1971

Some properties and zone structure of the ternary compound CdGeAs_2 . F. M. Gashimzade, N. A. Goryunova, E. O. Osmanov.

Electrical properties of monocrystalline samples of ZnSnAs_2 . N. A. Goryunova, F. P. Kesamanly, D. N. Nasledov, Yu. V. Rud'.
 1971

Investigation of properties of ZnGeP_2 and CdGeP_2 . N. A. Goryunova, N. K. Takhtareva, I. I. Tychina.

On the question of the existence of homogeneous many-component tetrahedral phases. G. K. Aberkiyeva, A. A. Vaynolin, N. A. Goryunova.

X-Ray investigation of certain compounds of the type $\text{A}^{\text{II}}\text{B}^{\text{IV}}\text{C}_2^{\text{VI}}$. A. A. Vaynolin, E. O. Osmanov, Yu. V. Rud', I. I. Tychina, A. F. Lindin, N. A. Goryunova, A. F. Iyevin'sh.

Investigation of the system germanium-sulfur and germanium-selenium.
A. S. Pashinkin, Lyu-Tsun'-Khua, A. V. Novoselova (10 minutes).

(Not presented).]

Thermodynamic investigation of alloys of the system gallium-antimony.
L. N. Gerasimenko, N. A. Goryunova, I. V. Kirichenko, L. N. Lozhkin,
A. G. Morachevskiy (10 minutes).

Report presented at the 3rd National Conference on Semiconductor Compounds,
Kishinev, 16-21 Sept 1963

L 10767-63 EWT(1)/ENP(q)/EWT(m)/EDS/
EEG(B)-2--AFFTC/ASD/ESD-3--P1-4--ID/JG

ACCESSION NR: AP3003914

S/0181/63/005/007/2031/2032

AUTHOR: Goryunova, N. A.; Kassamany*, F. P.; Osmanov, E. O.

TITLE: Preparation and certain properties of single-crystal specimens of CdGeAs₂

SOURCE: Fizika tverdogo tela, v. 5, no. 7, 1963, 2031-2032

TOPIC TAGS: CdGeAs₂, single crystals, physical properties, mechanical properties, electrical properties, carriers, electrons, holes, mobility of carriers, effective mass of electrons

ABSTRACT: Single-crystal specimens of CdGeAs₂ have been prepared by an unidentified method, and their properties have been studied. The compound has the structure of chalcopyrite with the parameters $a = 5.9427 \text{ \AA}$, $b = 11.2172 \text{ \AA}$, and $c/a = 1.8875 \text{ \AA}$, all $\pm 0.0005 \text{ \AA}$. It melts at 665°C and has a microhardness of $471 \pm 10 \text{ kg/mm}^2$. The forbidden energy gap at 300K is 0.53 eV. Electrical measurements were carried out with parallelepipedal specimens ($1 \times 3 \times 10 \text{ mm}$); low-resistance contacts were realized by indium electrodes. The Hall mobilities of holes and electrons in samples with a carrier density of 10^{17} cm^{-3} at room temperature were 20 to 25 and 800 to 1000 cm^2/vsec , respectively. The thermoelectric power of an n-type sample at 300K was 190 $\mu\text{V/deg}$. The maximum possible value of

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ACCESSION NR: AP3003914

the effective mass of electrons (m^*) was evaluated as about $0.27 m_0$. In view of the low value of m^* , it can be assumed that the value obtained for the electron mobility is considerably lower than the possible value. This phenomenon can be associated with the presence of a great amount of compensated impurities. Compound $CdGeAs_2$ is being studied in more detail. "The authors thank E. N. Mamontova and A. A. Vaypolin for their assistance in determining the forbidden energy gap and identity period and D. N. Nasledov for his interest in and attention to the study."

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad
(Physicotechnical Institute AN SSSR)

SUBMITTED: 14Mar63

DATE ACQ: 15Aug63

ENCL: 00

SUB CODE: 00

NO REF SOV: 003

OTHER: 003

27/14
Card 2/2

S/070/63/008/002/011/017
E073/E335

AUTHORS: Ozolin'sh, G.V., Averkiyeva, G.K., Goryunova, N.A.
and Iyevin'sh, A.F.

TITLE: X-ray investigation of gallium and indium antimonides

PERIODICAL: Kristallografiya, v. 8, no. 2, 1963, 272

TEXT: To elucidate the width of the range of homogeneity in type $A_{III}B_V$ compounds the exact lattice constants of indium and gallium antimonides were determined by the asymmetric method, using the technique described in an earlier published paper of the author. The preparations were synthesized both in the stoichiometric composition as well as with deviations by 50 mole.% to both sides of the stoichiometric composition. The latter preparations showed a second phase which could be detected on polished sections and on X-ray diffraction patterns. The microhardness of the basic phase ($A_{III}B_V$) for these preparations corresponded to the microhardness of the compounds. The gallium antimonide was photographed using chromium and copper radiation. Indium antimonide was photographed using cobalt and nickel radiation and 23 exposures were made. The following lattice

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X-ray investigation

constants were obtained (\AA):

	GaSb	InSb
Stoichiometric composition	6.09614	6.47965
Excess 50% Sb	6.09613	6.47961
Excess Ga or In	6.09609	6.47962.

The divergence between the lattice constants of the preparations with the stoichiometric composition and those which deviated from the stoichiometric was insignificant and fully within the limits of error of the method ($\pm 0.0001 \text{ \AA}$). In the same way as in the case of indium and gallium antimonides, the results of which were published earlier by the authors, the here obtained results lead to the conclusion that the lattice constants of the investigated compound type $A_{1-x}B_x$ do not depend on the excess A_{1-x} or B_x during their synthesis. The obtained results permit assuming, for the compounds investigated, the following most likely magnitudes of the lattice constants: for GaSb $a = 6.09612 \pm 0.00009 \text{ \AA}$; for InSb $a = 6.47962 \pm 0.00012 \text{ \AA}$ at $+25^\circ \text{C}$ without correction for refraction. The here given errors are maximal and calculated.

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X-ray investigation

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as three times the mean square error.

ASSOCIATIONS: Institut khimii AN LatvSSR
 (Institute of Chemistry of the AS Latvian SSR)
 Fiziko-tekhnicheskii institut AN SSSR
 (Physicotechnical Institute of the AS USSR)

SUBMITTED: October 15, 1962

Card 3/3

GORYUNOVA, N.A.; SOKOLOVA, V.I.; TSZYAN BIN-SI [Chiang Ping-hsi]

Dissolution of germanium in some ternary semiconducting compounds. Dokl. AN SSSR 152 no.2:363-366 S '63.

(MIRA 16:11)

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Predstavleno akademikom B.P. Konstantinovym.